U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Docket No.: 50-346
License No.: NPF-3

Report No.: 50-346/97002(DRS)

Licensee: Toledo Edison Company

Facility: Davis-Besse Nuclear Power Station

Location: 5503 N. State Route 2
Oak Harbor, OH 43449

Dates: January 13 - 17, 1997

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EXECUTIVE SUMMARY

Davis-Besse Nuclear Power Station, Unit 1
NRC Inspection Report 50-346/97002(DRS)

This inspection included a review of the licensee's implementation of 10 CFR 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants." The report covers a one week on-site inspection by regional and Office of Nuclear Reactor Regulation (NRR) inspectors.

Operations

- Operators' knowledge was consistent with their responsibility for implementation of the maintenance rule (MR). There was no indication that the maintenance rule detracted from the operators' ability to safely operate the plant. Using the Risk Significant System Matrix chart helped operators monitor and limit risk.

Maintenance

- The team concluded that the Davis-Besse structures, systems, and components (SSC) were properly scoped although documentation to support scoping decisions was weak.

- The expert panel was composed of well-qualified, experienced personnel. The Davis-Besse Individual Plant Examination (IPE) was used in conjunction with the panel's experience base to accurately assess the risk significance of the SSCs. No formal administrative procedures or guidance had been developed to govern expert panel activities.

- Based on the reviews conducted, the team determined that the licensee's approach to establishing the risk ranking for SSCs within the scope of the Maintenance Rule (MR) was adequate. However, weaknesses in that approach included the use of an outdated IPE and inadequate documentation of the expert panel's determinations.

- The procedures for performing periodic evaluations met the requirements of the rule and the intent of the Nuclear Management Resource Council (NUMARC) implementing guidance. The team noted that the reports addressed all of the aspects specified in NUMARC 93-01 "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," and 10 CFR 50.65(a)(3). The team considered the preparation of system-specific periodic reports as a significant strength.

- The licensee's process for conducting the balance between reliability and availability was considered acceptable. Changes to the preventive maintenance program were indicative of an ongoing effort to optimize reliability and availability.

- The team viewed the licensee's process for assessing plant risk resulting from multiple equipment outages to be appropriate. However, the tool used to assess plant risk while at power, the risk matrix, was viewed as weak in terms of making use of IPE risk information and providing user guidance.

- The establishment of performance criteria and goal setting was considered good. The use of specific functional failure (FF) performance criteria for non-risk significant SSCs, along with maintaining plant level performance criteria, was a program strength. Performance criteria for reliability for safety significant SSCs, however, were deficient in that the FF criteria were not based on demands or run time. Based on the recent efficient use of outage times for several SSCs, the effectiveness of the unavailability performance criteria as an indicator may have been reduced.

- The licensee adequately scoped buildings and enclosures as structures under the rule. However, the structure monitoring program concentrated only on building supports and did not consider system and internal component supports. Further, no guidance was established for moving structures between the (a)(2) and (a)(1) categories.

- The team concluded that the licensee had properly integrated the MR into the existing industry operating experience (IOE) program. Adequate provisions had been made to incorporate information from the IOE program into periodic evaluations, goal development, and functional failure evaluations.

- The material condition of the plant systems examined was very good. With a few minor exceptions, the systems appeared to be well-managed and were free of corrosion, oil, water, steam leaks, and extraneous material.

Quality Assurance (QA)

- The team concluded that the licensee's self-assessment activities were appropriately conducted and identified worthwhile issues. Use of independent personnel was considered a strength of the 1995 self-assessment. The team further concluded that Audit 96-MAINT-01 was also a worthwhile effort although it did not identify a significant deficiency (lack of criteria for reclassifying a structure from (a)(2) to (a)(1)) in the structure monitoring program).

Engineering

- System engineers (SE) had been trained and appeared qualified to provide oversight of the implementation of the rule for their respective SSCs. The team also noted that system engineers were actively involved in MR implementation and generally viewed the MR as a useful tool.

Report Details

Summary of Plant Status

The plant was operating at full power during the inspection.

Introduction

This inspection included a review of the licensee's implementation of 10 CFR 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants." The report covers a one week on-site inspection by regional and NRR inspectors.

I. Operations

04 Operator Knowledge and Performance

04.1 Operator Knowledge of Maintenance Rule

a. Inspection Scope (62706)

During the inspection of the implementation of 10 CFR 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," the team interviewed two licensed reactor operators and three senior reactor operators to determine if they understood the general requirements of the rule and their particular duties and responsibilities for its implementation.

b. Observations and Findings

The team found that the operators had a general working knowledge of the maintenance rule and their role in its implementation. They stated their primary duties included review of maintenance activities and comparison of these activities with the risk significant system matrix (RSSM) chart. They stated that they used the RSSM matrix chart to aid in identifying systems that were within the scope of the station's maintenance rule program. In addition, they were tasked with the timely removal and restoration of equipment and accounting of equipment out-of-service time.

Tasks associated with the maintenance rule that operators were responsible for included:

- Returning all SSCs to service as soon as possible in order to minimize unavailabilities
- Documenting SSC outages in the control room log for all SSCs under the scope of the maintenance rule
- Noting when equipment was taken out-of-service and when equipment was returned to service

The operators indicated that the maintenance rule was integrated with their day-to-day activities, and that it did not impose additional administrative burdens that distracted them from their responsibility to safely operate the plant.

c. Conclusions

Operators' knowledge was consistent with their responsibility for implementation of the maintenance rule. There was no indication that the maintenance rule detracted from the operators' ability to safely operate the plant. Using the RSSM chart helped operators monitor and limit risk.

II. Maintenance

M1 Conduct of Maintenance (62706)

The primary focus of the inspection was to verify that the licensee had implemented a maintenance monitoring program which satisfied the requirements of 10 CFR 50.65, "Requirements for Monitoring the Effectiveness of the Maintenance at Nuclear Power Plants," (the maintenance rule). The inspection was performed by a team of five regional and headquarters inspectors and a consultant from the Idaho National Engineering Laboratory. Assistance and support were provided by one member of the Quality Assurance and Maintenance Branch, NRR.

M1.1 SSCs Included Within the Scope of the Rule

a. Inspection Scope

The team reviewed the licensee's scoping documentation to determine if the appropriate SSCs were included within their maintenance rule program in accordance with 10 CFR 50.65(b). The team used Inspection Procedure 62706, Maintenance Rule, NUMARC 93-01, and Regulatory Guide 1.160 as references during the inspection.

b. Observations and Findings

The licensee's maintenance rule was described in procedure MRPM-02, "Maintenance Rule Program Manual," Revision 2 (December 15, 1996). This program described the methodology used to select the SSCs under the MR. The methodology considered whether SSCs were safety related, whether failures could cause accidents or transients, were used in Emergency Operating Procedures (EOP), whether SSC failure resulted in safety-related system failure, or failures could cause a safety-related system actuation and non-safety-related SSCs used to mitigate accidents or transients. Based on results of these evaluations, lists were developed of systems within the scope of the MR and of systems excluded from the scope of the MR.

In general, the scoping of SSCs was conservative. The licensee considered about 290 sub-systems and components in the initial scoping phase. Through a process of consolidation, this was reduced to 89 SSCs; of these, about 60 SSCs were placed within the scope of the MR. The team noted that the licensee had little documentation to support their decisions as to whether a system should be placed within the scope of the MR. Documentation available for review consisted of SSC scoping sheets which included the four basic questions in NUMARC 93-01 with little documentation to support the answers to the questions.

c. Conclusions

The team concluded that the Davis-Besse SSCs were properly scoped although documentation to support scoping decisions was weak.

M1.2 Safety (Risk) Determination, Risk Ranking, and Expert Panel

a. Inspection Scope

Paragraph (a)(1) of the rule requires that goals be commensurate with safety. Additionally, implementation of the rule using the guidance contained in NUMARC 93-01, required that safety be taken into account when setting performance criteria and monitoring under paragraph (a)(2) of the rule. This safety consideration was to be used to determine if the SSC should be monitored at the system, train or plant level. The team reviewed the methods and calculations that the licensee established for making these risk determinations. The team also reviewed the risk determinations that were made for the specific SSCs reviewed during this inspection. NUMARC 93-01 recommended the use of an expert panel to establish safety significance of SSCs by combining Probabilistic Risk Assessments (PRA) insights with operations and maintenance experience, and to compensate for the limitations of PRA modeling and importance measures. The team reviewed the composition of the expert panel and experience and qualifications of its members. The team reviewed the licensee's expert panel process and the information available which documented the decisions made by the expert panel. The team interviewed several members of the expert panel to determine their knowledge of the MR and to understand the functioning of the panel.

b.1 Observations and Findings on the Expert Panel

The licensee used an expert panel referred to as the "Maintenance Rule Working Group," in conjunction with a PRA ranking methodology to determine the safety significance of SSCs within the scope of the MR. The panel included a PRA analyst and representatives from operations, maintenance, engineering, and planning. Average nuclear experience of the panel members was more than 12 years. In addition, the MRPM permitted subject matter experts to supplement the panel, as needed.

The expert panel held quarterly meetings to review the quarterly equipment windows and the periodic maintenance effectiveness assessment report to ensure performance monitoring and goal setting activities were proceeding as desired. The team reviewed minutes of the panel's quarterly meetings. The minutes appeared to provide an accurate description of the panel's general activities as the activities were described to the team by the panel members.

The team noted that no formal charter or procedure had been developed to govern the activities of the expert panel, nor was there any criteria for selection of panel members as to experience, training, or level of expertise. There was no quorum established for other than decisions to alter the implementation of the rule, nor were alternates identified for the five panel members.

Interviews with panel members indicated that they were knowledgeable in the requirements of the MR, system scoping, use of the PRA in risk assessment, and were able to accurately assess risk significance of the SSCs.

c.1 Conclusions on Expert Panel

The expert panel was composed of well-qualified, experienced personnel. PRA was used in conjunction with their experience base to accurately assess the risk significance of the SSCs. No formal administrative procedures or guidance have been developed to govern expert panel activities.

b.2 Observations and Findings on Risk Determinations

b.2.1 Analytical Risk Determining Methodology

During the inspection, the team reviewed the Davis-Besse Individual Plant Examination (IPE), Individual Plant Examination of External Events (IPEEE), and Safety Evaluation Report (SER) of the IPE, and interviewed the IPE representatives. The IPE was a small event tree and large fault tree model, and the "CAFTA" computer code was used to develop and quantify the model. The team judged the IPE to be acceptable for support of the MR. (It should be noted that the SER concluded that the IPE met the requirements of Generic Letter 88-20, "Individual Plant Examination for Severe Accident Vulnerabilities," and associated guidance in NUREG-1335, "Individual Plant Examination: Submittal Guidance.") However, the IPE, submitted in February 1993, had not been updated to support the MR. Therefore, IPE design, unavailability, and unreliability data were representative of the plant prior to 1991. Not having updated the IPE to reflect more recent plant data was considered by the team to be a weakness in the implementation of the MR.

b.2.2 Adequacy of Expert Panel Evaluations

The licensee's process for establishing the risk significance of SSCs within the scope of the MR was documented in the Davis-Besse MRPM, Section 5.6 and Attachment 7, intra-company memorandum NEN-95-10115, and minutes of the Working Group (expert panel) meetings. These documents were reviewed and found to adequately describe the process of determining risk significance.

For SSCs modeled in the licensee's IPE, three importance measures were evaluated (core damage frequency contribution, risk achievement worth, and risk reduction worth), as recommended in NUMARC 93-01. The licensee first evaluated the IPE basic events relative to the core damage frequency contribution criterion. Then the remaining IPE cut sets and basic events were evaluated with respect to the other two importance measure criteria. If a basic event's importance measure met one or more of the criteria, then the SSC associated with that basic event was judged to be potentially risk significant. Because NUMARC 93-01 guidance indicated that a basic event was potentially risk significant if any of the three importance measure criteria were met, the approach used by the licensee was acceptable. The Working Group then made the final determinations with respect to risk significance. Several SSCs indicated to be risk significant from the IPE importance measures were downgraded to non-risk significant. Documentation of these cases was provided in Attachment 7 of the MRPM and NEN-95-10115. The team found that sufficient information was presented in those documents to justify the downgrading of those SSCs.

For SSCs not modeled in the IPE, the Working Group determined the risk significance. Although the final risk significance results were appropriate, the details of the Working Group determinations were not adequately documented.

Finally, the original IPE (February 1993) was used to support the risk significance determinations. That IPE generally reflected plant conditions before 1991. Therefore, a weakness in the licensee's risk significance determinations was the use of an IPE that had not been updated since its original submittal.

c.2 Conclusions on Risk Determinations

Based on the reviews discussed above, the team determined that the licensee's approach to establishing the risk ranking for SSCs within the scope of the MR was adequate. However, weaknesses in that approach included the use of an outdated IPE and inadequate documentation of the Expert Panel's determinations.

M1.3 (a)(3) Periodic Evaluations

a. Inspection Scope

Section (a)(3) of the rule requires that performance and condition monitoring activities and associated goals and preventive maintenance activities be evaluated, taking into account where practical, industry wide operating experience. This evaluation was required to be performed at least one time during each refueling cycle, not to exceed 24 months between evaluations. The team reviewed the procedural guidelines for these evaluations and two periodic reports.

b. Observations and Findings

The licensee's instructions for conducting periodic evaluations were contained in procedure DB-PF-00002 "Preventive Maintenance Program," Revision 00, Section 6.4. The procedure generally provided adequate guidance for preparing evaluations which would meet the requirements of 10 CFR 50.65(a)(3) and the intent of NUMARC 93-01. One identified exception involved the MR requirement to incorporate industry experience into the periodic evaluation. DB-PF-00002, Section 6.4.1.e specified three sources to be used, thus procedurally eliminating other, equally good sources of industry experience. The team noted that the licensee's operating experience assessment program (discussed in section M1.8) was not as restrictive. After discussing this with the MRC, the team concluded that this was inadvertent. The MRC indicated that the step would be corrected to remove the restriction.

The team reviewed the following:

- Cycle 9 Periodic Maintenance Effectiveness Assessment Period (July 1993 - November 1994)
- Cycle 10 Periodic Maintenance Effectiveness Assessment Period (November 1994 - May 1996)

The team noted that the cyclic periodic reports contained an overall plant summary and individual, system-specific periodic reports for all the systems within the scope of the MR. Both the summary and the system-specific reports addressed all of the aspects specified in NUMARC 93-01 and 10 CFR 50.65(a)(3). The team considered the preparation of system-specific periodic reports as a significant strength.

c. Conclusions

The procedures for performing periodic evaluations met the requirements of the rule and the intent of the NUMARC implementing guidance. The team noted that the reports addressed all of the aspects specified in NUMARC 93-01 and 10 CFR 50.65(a)(3). The team considered the preparation of system-specific periodic reports as a significant strength.

M1.4 (a)(3) Balancing Reliability and Unavailability

a. Inspection Scope

Paragraph (a)(3) of the MR requires that adjustments be made where necessary to assure that the objective of preventing failures through the performance of preventive maintenance was appropriately balanced against the objective of minimizing unavailability due to monitoring or preventive maintenance. The team reviewed the licensee's plans to ensure this evaluation was performed as required by the rule.

b. Observations and Findings

The licensee's basis for balancing reliability and availability was contained in Section 13 of the MRPM and reflected a qualitative method that was consistent with NUMARC 93-01 guidance and industry practice.

The licensee's approach for optimizing availability and reliability was achieved by properly scheduling testing and maintenance activities to minimize the overall unavailability of the SSC and to maximize the reliability. During refueling cycle 10, the licensee made approximately one thousand changes to preventive maintenance activities to optimize SSC reliability and availability. Scheduling efficiency was continually improved by applying lessons learned from operating cycle mini-schedules as found in Work Process Guideline WPG-1 R04. The team also noted that evaluations of the reliability/availability balance were included in both the overall and plant-specific periodic evaluations.

c. Conclusions

The licensee's process for conducting the balance between reliability and availability was considered acceptable. Changes to the preventive maintenance program were indicative of an ongoing effort to optimize reliability and availability.

M1.5 (a)(3) On-line Maintenance Risk Assessments

a. Inspection Scope

Paragraph (a)(3) of the MR requires that when removing plant equipment from service the overall effect on performance of safety functions be taken into account. The guidance contained in NUMARC 93-01 required that an assessment method be developed to ensure that overall plant safety function capabilities were maintained when removing SSCs from service for preventive maintenance or monitoring.

b. Observations and Findings

The licensee's process for determining plant safety when equipment was taken out of service was documented in the MRPM, Section 8 and Attachment 2. While the plant was at power, the licensee's process was outlined in the Work Process Guideline, WPG-1, which is supported by intra-company memorandum NEN-95-10113. When the plant was shut down, the process was outlined in Outage Nuclear Safety Control, NG-PS-00116.

While the plant was at power, the "Risk Significant System Matrix" (Attachment 9 in WPG-1) was used by work planners and Senior Reactor Operators (SROs) to evaluate plant risk for concurrent outages of risk significant SSCs. The risk matrix was developed with the support of the IPE, as outlined in NEN-95-10113. The licensee used a 12-week rolling schedule for planning surveillances and preventive maintenance. The work planners used the risk matrix to prevent planned concurrent equipment outages that would place the plant in a potentially high risk situation (indicated by "X" in the risk matrix). The SROs performed a final evaluation of planned outages against the risk matrix before each work week began. For combinations of equipment outages not covered by the risk matrix, SROs and work planners used their experience and judgment to evaluate the plant risk. (A review of requests for risk determinations identified a case in which a work planner requested a risk determination for planned concurrent outages of SSCs not all covered by the risk matrix.)

The risk matrix used by the licensee was considered to be weak in terms of effective use of IPE information to evaluate plant risk from concurrent equipment outages. Specific issues were the following:

- The matrix provided no explicit guidance for assessing plant risk when three or more pieces of equipment were out-of-service at the same time. Such combinations might place the plant in a high risk situation without the user realizing this. (It should be noted that the users of the risk matrix indicated that they would request a risk determination for outages of three or more risk significant SSCs. However, that guidance was not in the procedure.)

- There was no guidance for recovery from high risk configurations resulting from emergent failures (no guidance on determining which piece of equipment to return to service first).

The procedures used by the licensee for plant shutdown conditions appeared to be the standard industry approach, based on NUMARC 91-06, INPO guidelines for outage management, and EPRI guidance.

c. Conclusions

The team viewed the licensee's process for assessing plant risk resulting from multiple equipment outages to be appropriate. However, the tool used to assess plant risk while at power, the risk matrix, was viewed as weak in terms of making use of IPE risk information and providing user guidance.

M1.6 (a)(1) Goal Setting and Monitoring and (a)(2) Preventive Maintenance

a. Inspection Scope

The team reviewed program documents in order to evaluate the process established to set goals and monitor under (a)(1) and to verify that preventive maintenance (PM) was effective under (a)(2) of the rule. The team also discussed the program with appropriate plant personnel. The team reviewed the following systems:

(a)(1) systems

Switchyard/Transformers
Freeze Protection
Component Cooling Water
Control Room Emergency Ventilation System
Safety Features Actuation System

(a)(2) systems

Turbine-generator
Auxiliary Feedwater
Radiation Monitors
Service Water

The team reviewed each of these systems to verify that goals or performance criteria were established in accordance with safety, that industry wide operating experience was taken into consideration where practical, that appropriate monitoring and trending were being performed, and that corrective actions were taken when an SSC failed to meet its goal or performance criteria or experienced a maintenance preventible functional failure (MPFF). The team also reviewed performance criteria for SSCs not listed above.

The team reviewed the licensee's process to evaluate onsite passive structures for inclusion under the MR. Structures evaluated by the team included buildings, enclosures, storage tanks, earthen structures, and passive components and materials housed in the aforementioned. In addition, the team assessed by what means performance of structures determined to be within scope were monitored for degradation.

b. Observations and Findings

The team found that the plant MRPM, Revision 2, provided appropriate guidelines for establishing performance criteria/goals for SSCs scoped under the MR. The licensee had established performance criteria and/or goals for all systems designated within scope. The performance criteria/goals were documented and retrievable. System engineers were knowledgeable of the performance criteria/goals for the assigned systems. The team did not identify any functional failures that were not previously identified by the licensee. However, as discussed below, the team identified cases where reliability related performance criteria had not been properly established for certain risk significant SSCs.

b.1 Performance Criteria for Unavailability

Section 9.3.2 of NUMARC 93-01 recommended that risk significant SSC performance criteria be set to assure that the availability and reliability assumptions used in the risk determining analysis (i.e., PRA) were maintained. The team evaluated the licensee's performance criteria to determine if they had been adequately set under (a)(2) of the MR, consistent with the assumptions used to establish SSC safety significance.

The team reviewed the 29 licensee-specified risk significant SSCs, and identified that reliability performance criteria had been set (the adequacy of these reliability criteria is discussed below). For ten risk significant SSCs, the licensee had not established specific unavailability criteria. For these SSCs, any unavailability would have caused a plant trip or required a plant shutdown (e.g., DC power, main steam, reactor coolant, steam generators) and, as such, the licensee considered monitoring unavailability as not meaningful. Problems with these systems would be adequately monitored by functional failures. This was considered reasonable and acceptable.

The team noted that the majority of unavailability goals and performance criteria established for high safety significant SSCs were less conservative than the unavailability values assumed in the PRA. Unavailability performance criteria generally were twice the PRA value. The licensee had recalculated the Core Damage Frequency (CDF) value using the MR performance criteria unavailability values. The results of Calculation No. C-NSA-99.16-19, Rev. 1, indicated that the CDF changed from 6.57E-5 to 5.76E-5. Based on this slight increase (11%) in the CDF, the team determined that the unavailability performance criteria established for high safety significant SSCs were acceptable.

The MR unavailability performance criteria in most cases were based on a 3-year average unavailability multiplied by two. As a result of the rule, system engineers have become more attuned to PM on systems taken out-of-service, such that PM activities were being consolidated, frequencies revised, and scheduled during system min-outages to reduce system unavailability. As a result, unavailability was reduced on a number of systems, however, the performance criteria were still based on historic data. Although unavailability criteria did not significantly affect CDF, the licensee should ensure the performance criteria established remains reasonable based on the improved PM methodology.

b.2 Performance Criteria for Reliability

The licensee established, as reliability related performance criteria, no repetitive FFs, and either greater than zero or greater than one FFs per cycle for 26 of the 29 risk significant SSCs. The use of FFs was considered better than MPFFs. However, at the time of the inspection, the licensee had not performed a sensitivity analysis that demonstrated that the performance criteria used for reliability preserved the assumptions used in the PRA, or that the use of these reliability performance criteria did not have an adverse impact on risk ranking. The team noted that there was no relationship established between these criteria and the failure probability assumptions in the PRA, since the number of function demands and/or equipment run times were not considered. Thus, widely different SSC reliability estimates (probability of failure upon demand or per hour) could result from the same number of FFs in a specified time period if the number of demands or operating times varied between periods. The licensee failed to determine the sensitivity of the PRA to these unreliability performance criteria.

As such, the failure to couple the number of FFs to the failure probability assumptions in the PRA was considered to be a violation of 10 CFR 50.65(a)(1), failure to define performance monitoring criteria which demonstrate acceptable performance commensurate with safety (VIO 50-346/97002-01(DRS)).

For two SSCs, emergency diesel generator (EDG) and standby blackout diesel generator, a 95% reliability performance criterion was established. For the containment system, the reliability performance criteria were based on leakage rates. These criteria were considered acceptable reliability performance criteria.

b.3 Performance Criteria for Non-risk Significant Normally Operating SSCs

The licensee had established specific performance criteria (FFs/cycle) for non-risk significant normally operating SSCs, although the guidance in NUMARC 93-01 only required plant-level performance criteria for these SSCs. This was considered a significant improvement over the NUMARC guidance in that the FF criteria would better assess the SSC being monitored. The placement of the freeze protection system into (a)(1) due to several FFs was the result of establishing SSC specific criteria.

The licensee also established six plant-level performance criteria that included the following:

- unplanned automatic reactor trips per 7000 critical hours
- unplanned unit capability loss factor
- unit capability factor

- adjusted heat rate
- containment leakage
- non-risk significant (a)(2) functional failures

If a plant level performance criterion was exceeded, an evaluation would be performed to determine the cause. If the evaluation could determine a specific SSC as the root cause for the performance criterion being exceeded, then that SSC would be considered for transfer to category (a)(1).

b.4 Goals Established for (a)(1) SSCs

The goals established for all SSCs placed in (a)(1) were the same as the previously established performance criteria for that SSC. The licensee had determined that the performance criteria were adequate to monitor the SSC's corrective actions such that additional goals were not necessary. The team concurred that in these cases the performance criteria were acceptable goals. The licensee also stated specific goals would be established if the established performance criteria would not effectively monitor the SSC's corrective actions.

The licensee had dispositioned two SSCs from (a)(1) to (a)(2) by redefining what constitutes a FF of the SSC. This change, which required a system/train failure versus a component/channel failure resulted in not classifying several component/channel failures as FFs, such that the SSCs' performance criterion was not exceeded. The team did not have a concern with the licensee's position on what was considered a FF in these cases. These examples are further discussed in section M2.1.b of this report.

b.5 Structures and Structure Monitoring

The team reviewed procedure M/S DG-26, "Design Guideline for Maintenance Rule Evaluation of Structures," and other associated licensee programmatic controls to determine which onsite structures were evaluated for inclusion under the rule. Additionally, a review of the performance criteria and monitoring established for structures within scope was performed.

The team identified several good aspects of the structure monitoring program including: 1) scope included the structures required to be monitored by the MR, 2) contained specific checklist guidance for evaluating structures, including some quantitative performance criteria, 3) required qualified individuals to conduct the walkdown, including a licensed professional engineer, 4) divided structures within scope of the rule into individual rooms to ensure all areas would be inspected, and 5) used existing programs to support structural monitoring.

The licensee's initial structural walkdown frequency was selected as every four years and would be revised based on the results of the baseline walkdowns. Some structures, such as the cooling tower and intake structure, were already on a refueling outage frequency based on previous existing programs. Although the baseline structural walkdowns have not been completed, the licensee did have a draft schedule to complete the remaining walkdowns by 1998. The team reviewed the walkdown checklists completed for the containment building during the last outage and noted that minor deficiencies that did not affect the structures function were being documented, and resolved if required. No major concerns were identified by the licensee on the containment structures where walkdowns have been completed.

Although there appeared to be a good foundation for the structural monitoring program, two issues were also identified. The program's baseline inspections only concentrated on the buildings' supports (i.e., walls, ceiling, structural steel) and not supports (e.g., pump pedestals, pipe supports) contained within the building. Inspection of these supports was left to the system engineers; however, the system engineering handbook did not specifically address this requirement when conducting walkdowns. Although several system engineers indicated they look at supports during the weekly walkdowns, the team was concerned that these walkdowns may not be adequate to baseline these supports for the MR.

The second issue involved dispositioning a structure from (a)(1) to (a)(2) or (a)(2) to (a)(1). The program stated these decisions would be evaluated by the expert panel, however, there was no guidance in the program for the expert panel to use to make this evaluation. Concerns with the lack of expert panel guidance were previously discussed in section M1.2.b.1 of this report.

Since the baseline inspections for the structure monitoring program were not sufficiently completed to evaluate whether these two issues conform with regulatory requirements or industry guidelines, this was considered an unresolved item pending further NRC review of the baseline inspections and the dispositioning of structures between the (a)(2) and (a)(1) categories under the Rule (URI 50-346/97002-02(DRS)).

c. Conclusions

The establishment of performance criteria and goal setting was considered satisfactory. The use of specific FF performance criteria for non-risk significant SSCs, along with maintaining plant level performance criteria was a program strength. Reliability performance criteria for safety significant SSCs, however, were deficient in that the FF criteria were not based on demands or run time. Based on the recent efficient use of outage times for several SSCs, the effectiveness of the unavailability performance criteria may have been reduced.

The licensee had adequately scoped buildings and enclosures as structures under the Rule. However, the structure monitoring program concentrated only on building supports and not internal component supports and no guidance was established for moving structures between the (a)(2) and (a)(1) categories under the Rule.

M1.8 Use of Industry-wide Operating Experience

a. Inspection Scope

Paragraph (a)(1) of the rule states that goals shall be established commensurate with safety and, where practical, taking into account industry-wide operating experience. Paragraph (a)(3) of the rule states that performance and condition monitoring activities and associated goals and PM activities shall be evaluated at least every refueling cycle. The evaluation shall be conducted taking into account industry-wide operating experience. The team reviewed the licensee's program to integrate industry operating experience (IOE) into their monitoring program for maintenance.

b. <u>Observations and Findings on Use of Industry-wide Operating Experience</u>

The licensee procedure NG-NA-00305, Revision 01, "Operating Experience Assessment Program," provided the administrative guidelines to integrate industry-wide operating experience, in addition to the processing of in-house experience that may be of interest to the industry.

Interviews and the review indicated that a structured process existed for evaluating and processing IOE. The process transferred information to the SEs, about events that were received by the operating experience (OE) group. In addition, OEs were also screened separately by the Nuclear Network Coordinator. All OEs were also summarized in a routine OE Report (OER) which was prepared by Independent Safety Engineering and distributed to a wide range of interested and cognizant individuals. This process also included a monthly memo to file which documented the disposition of all operating experience reports that were received the preceding month. This memo also identified OERs deemed not applicable to Davis-Besse. The formal review included the completion of an OER Screening Checklist by the independent safety engineering reviewer. The team found that SEs were able to discuss the program, formal and informal, and how they used the information to identify system improvements as well as the mechanism to process the sharing with the industry of in-house information.

c.2 <u>Conclusions for Use of Industry wide Operating Experience</u>

The team concluded that the licensee had properly integrated the MR into the existing IOE program. Adequate provisions had been made to incorporate information from the IOE program into the periodic evaluation, goal development, and functional failure evaluations.

M2 Maintenance and Material Condition of Facilities and Equipment (61706, 71707)

M2.1. <u>General System Review</u>

a. <u>Inspection Scope</u>

The inspectors conducted a detailed examination of several systems from a MR perspective to assess the effectiveness of the licensee's program when it was applied to individual systems.

b.1 <u>Observations and Findings for the Switchyard/Transformers</u>

The team reviewed the performance criteria for the switchyard and transformers and noted that the licensee had established a reliability performance criterion of one functional failure per cycle. The system had been correctly classified as risk significant.

The system was placed in category (a)(1) in the second quarter of 1995 due to experiencing two failures that were initially classified as FFs. Breaker 34562 developed an air leak which rendered the breaker inoperable. The licensee rebuilt all five of the 345kV breakers. Although breaker 34562 was inoperable, ability to supply power from the ring bus was not lost, so the licensee determined that the switchyard did not experience a functional failure. Another failure for the SSC was the deenergization of startup transformer X02. A mayfly swarm, attracted by lighting in the vicinity of the transformer, initiated a flashover on the A phase lightning arrestor. The licensee cleaned and tested the transformer and returned it to service. Lighting in the vicinity of the transformer was redirected to avoid attracting mayfly swarms. The licensee reclassified this as a nonfunctional failure since the SSC was still able to perform its function of supplying power to both essential and non-essential loads. Based on the reclassification of these events the system was moved to category (a)(2). The team noted that the material condition of this SSC was good and that it was functioning as designed.

c.1 Conclusions for the Switchyard/Transformers

The licensee's initial classification of this system as (a)(1) was conservative; subsequent reevaluation of the FFs and reclassification of the system as category (a)(2) was appropriate.

b.2 Observations and Findings for the Freeze Protection System

The team reviewed the established performance criteria for the freeze protection/heat trace system. The team found that the licensee had established a performance criterion of three or less FFs per operating cycle. As noted in paragraph M1.6.b.3, plant level performance criteria would have been acceptable; however, as discussed below, the application of specific criteria resulted in better system monitoring.

The freeze protection system had been dispositioned from category (a)(2) to (a)(1) due to experiencing six FFs in cycle 10, including repetitive FFs caused by blown fuses. The SSC was still experiencing FFs in operating cycle 11 due to fuse failures. Most of the FFs had been caused by personnel plugging portable equipment into the duplex receptacles with the freeze protection circuits. The licensee had labeled the freeze protection associated circuits to avoid usage that could cause fuses to fail. The SSC was still in category (a)(1) at the end of this inspection.

c.2 Conclusions for the Freeze Protection System

The application of specific performance criteria to this low risk, normally operating system resulted in identification of system problems, categorization as (a)(1), and the development of focused corrective action. At the close of the inspection, the effectiveness of this action had not yet been determined.

b.3 Observations and Findings for the Turbine-Generator System

The team reviewed the performance criteria for the turbine-generator system and noted that the licensee had established a criterion of less than or equal to one FF per cycle, with no repetitive FFs.

This SSC had been in category (a)(2) for the previous two operating cycles. The system had been operating successfully with no automatic trips for the two previous cycles.

c.3 Conclusions for the Turbine-Generator System

The team concluded the turbine-generator system was appropriately classified and that system performance was good.

b.4 Observations and Findings for the Component Cooling Water (CCW) System

The team reviewed the performance criteria for the CCW system and noted that reliability criteria (less than one FF/cycle) had been established on a system basis. Unavailability criteria had been established on both a pump/system basis (less than 109 hours/year) and average ventilation train basis (less than 147 hours/year). The system was initially placed into (a)(1) category due to average pump unavailability being greater than the performance goal of 109 hours per year. This was due primarily to the past practice of performing work only on one shift.

The system was changed to category (a)(2) based on decreased system unavailability, due in part to performing work on an around-the-clock basis to minimize outage duration. There were no functional failures during cycle 10.

The team walked down portions of the component cooling water system areas with the system engineer and noted that the material condition of the equipment and the housekeeping were satisfactory.

c.4 Conclusions for the Component Cooling Water System

The team determined that reclassification of the system from category (a)(1) to (a)(2) was appropriate. The material condition of the system was satisfactory.

b.5 Observations and Findings for the Auxiliary Feedwater (AFW) System

The team reviewed the performance criteria for the AFW system and noted that both reliability (less than or equal to one FF/cycle) and unavailability (less than 130 hours/year) criteria had been established. The MR requirements were met by the AFW system, with average train unavailability being maintained less than the MR requirement. No FFs had been identified.

The team walked down portions of the AFW system with the system engineer and noted that the material condition of the equipment and the housekeeping were satisfactory.

c.5 Conclusions for the Auxiliary Feedwater System

The team concluded that the AFW system had been appropriately addressed under the licensee's MR program.

b.6 Observations and Findings for the Radiation Monitors

The team reviewed the performance criteria for the radiation monitors and noted that the licensee had established a criterion of less than or equal to three FFs per cycle with no repetitive FFs.

The age of the Geiger-Mueller tube and ion chamber detectors made them susceptible to failure, however, the current failure rate was considered by the licensee to be acceptable. The detectors were replaced on an as-fail basis.

Due to the poor performance of the containment radiation monitors, the licensee was considering requesting a Technical Specification change to delete the monitors' trip function or a modification to replace the monitors with a reliable model.

The team walked down portions of the radiation monitor system with the system engineer and noted that the material condition of the equipment and the housekeeping appeared satisfactory.

c.6 Conclusions for the Radiation Monitors

The team concluded that the radiation monitoring system had been appropriately addressed under the licensee's MR program.

b.7 Observations and Findings for the Safety Features Actuation System (SFAS)

The team reviewed the performance criteria established for the SFAS and noted that the licensee had established less than or equal to one risk significant FFs per cycle or less than or equal to two non-risk significant FFs per cycle as reliability performance criteria. No unavailability performance criterion was established as the system was considered operational basically 100% of the time. The licensee did not establish FFs per run time as the reliability performance criteria for this high safety (risk) significant system.

The SFAS system had been placed in (a)(1) due to FFs exceeding the performance criterion. The FFs concerned failures of radiation monitoring channels. The licensee subsequently revised the criteria for what was considered FFs. The evaluation determined that the failure of one channel would not prevent the system from operating, such that a FF would now be defined as the failure of one train (two channels). This definition would also be applicable to the reactor protection system (RPS) and steam and feedwater rupture control system, and consistent with the other systems within the MR scope. Based on this revision, there were no longer any FFs of SFAS and the system was returned to (a)(2). The team did not have any concerns with the evaluation or with returning the SSC to (a)(2).

c.7 Conclusions for the Safety Features Actuation System

The team concluded that the licensee's reclassification of the SFAS from category (a)(1) to (a)(2) was appropriate and that the system was being properly addressed by the licensee's MR program.

b.8 Observations and Findings for the Service Water (SW) System

The team reviewed the established performance criteria for the SW system and noted that the licensee established a reliability performance criterion of less than or equal to one FF per cycle, an unavailability performance criterion of 283 hours per year average for the three SW pumps, and an unavailability performance criterion of 865 hours per year for the dilution pump. The team found that the licensee did not establish FFs per number of demands or per run time as the reliability performance criteria for this high safety (risk) significant system.

The unavailability hours were determined by a 3-year average and multiplied by two for both the SW and dilution pumps. The majority of the unavailability hours came from scheduled 3-week PM every five years taken on each of the pumps. This was the reasoning behind the performance criterion being the average unavailability for the three pumps, as the PM outage would automatically have a single pump exceed the performance criterion. The licensee also stated that if one SW pump exceeded the 283 hours and was not the result of the 3-week PM, that pump would be considered for (a)(1). For Cycle 11, the SW pumps averaged 105.3 hours per year, while the dilution pump averaged 107.1 hours per year. The unavailability criterion for the dilution pump appeared high based on the recent data. Although the high number was understandable because of the 3-week PM, there could be a masking effect of pump problems that would not be evaluated by the unavailability criterion established.

Although there were no FFs associated with this system during the last cycle, there were a number of significant issues that were being addressed by engineering and included the following:

- Several Velan gate valves had experienced severe corrosion/galvanic action to the valves' stem/wedge interface that resulted in reduced flows to the emergency core cooling system (ECCS) room coolers. The licensee replaced a number of these valves to ensure a flow path for the coolers and intended to replace other valves in the system that also may be affected.

- The identification of zebra mussel shells in the CCW heat exchangers due to the loss of the chlorination system for 30 days in June 1995. Although there was no operability issue with the SW system resulting from shell blockage, the licensee conducted component inspections and flushed the system using higher than normal concentrations of Sodium Hypochlorite. As long term actions, the chlorination system was rebuilt and included as part of the SW SSC with respect to the MR, including possibly developing specific performance criteria for the chlorination system.

- As the result of intermittent low/high level alarms for the intake screens, the licensee identified 2-4 feet of silt in the intake bay. The bays were dredged to remove the silt and a refueling outage inspection/cleaning was instituted for the intake structure. A recent inspection by the licensee identified degradation of the intake crib in Lake Erie, which provided make-up to the ultimate heat sink. Licensee action on this issue had not been formulated at the time of the inspection.

c.8 Conclusions for the Service Water System

The team noted that a number of issues represented potential performance problems for the SW system. Although the licensee's unavailability criteria were acceptable under NUMARC 93-01 guidance and MRPM guidance, there was potential for system problems to be masked by incorporating the 3-week PM outage into the unavailability criterion.

b.9 Observations and Findings for the Control Room Emergency Ventilation System

The team reviewed the performance criteria established for Control Room Emergency Ventilation System (CREVS) and noted that the licensee had established a reliability performance criterion of less than or equal to two FFs per cycle and an unavailability performance criterion of 204 hours per year per train.

CREVS was an (a)(1) system due to three FFs during cycle 10. Two FFs were refrigerant leaks, both of which were considered repetitive. The first concerned a diaphragm failure on a valve actuator. The same valve had failed a year earlier. The failures were attributed to a manufacturing defect and additional degradation during shipping, storage, or valve assembly. A PM was generated to replace the diaphragms every five years and to inspect the diaphragms prior to installation for defects. The second set of refrigerant leaks occurred due to bumping of tubing during work in the CREVS room. A major modification scheduled for the next outage will relocate the control panels to reduce the number of instruments and refrigerant tubing lengths, and provide protection for remaining components. The third functional failure was a ground on the #2 chiller condensing fan motor that caused the loss of both trains of control room normal ventilation. The fan motor electrical fault was repaired. Corrective action completed or planned appear adequate to address the problems identified with CREVS.

System engineering continued to reduce system unavailability by consolidating maintenance activities. By performing mini-outages and improving personnel awareness of unavailability requirements, unavailability was reduced from 204 hours per year per train to 115 hours per year per train.

c.9 Conclusions for the Control Room Emergency Ventilation System

The team concluded that the classification of the CREVS as category (a)(1) was appropriate and that the licensee's corrective actions, both in progress and planned, appeared adequate. The team considered the reduction of system unavailability a direct result of properly implementing the MR.

M2.2 Material Condition

a. Inspection Scope

In the course of verifying the implementation of the MR using Inspection Procedure 62706, the team performed walkdowns using Inspection Procedure 71707, Plant Operations, to examine the material condition of the systems listed in section M1.6.

b. Observations and Findings

Except as noted in Section M2.1, the systems were free of corrosion, oil leaks, water leaks, trash, and based upon external condition, appeared to be well-maintained.

c. Conclusions

In general, the material condition of the systems examined was very good.

M7 Quality Assurance in Maintenance Activities (40500)

M7.1 Licensee Self-Assessments of the Maintenance Rule Program

a. Inspection Scope

The team reviewed the report of an assist visit by the Nuclear Energy Institute (NEI) which took place in 1995. The team also reviewed a sample of licensee self-assessment activities associated with maintenance. The documents reviewed included:

- Memorandum dated May 19, 1995: Maintenance Rule Assessment
- Memorandum dated September 5, 1995: Maintenance Rule Self-Assessment (Response)
- Toledo Edison Quality Assessment Audit AR-96-MAINT-01, dated January 3, 1997

b. Observations and Findings

The May 1995 self-assessment was conducted by a multi-disciplined team, which included members from other utilities. This approach provided an independent viewpoint which added to the overall quality of the assessment. The assessment was thorough and identified issues across a wide range of MR implementation aspects. The inspectors considered the findings in the "Program Concerns" and "Regulatory Concerns" to be especially valuable. Of particular note were the concerns expressed regarding the guidance for expert panel activities. While some corrective action was taken by the MR staff, the inspectors independently noted that guidance for and documentation of expert panel activities were still weak.

The team noted that MR implementation was a portion of Audit AR-96-MAINT-01, which was a comprehensive examination of the station's maintenance program. The team noted that NRC Inspection Procedure 62706, NUMARC 93-01, and other current guidance were used in conducting the audit. The team reviewed the portion of the Executive Summary pertaining to the MR and the two specific findings (AR-96-MAINT-01-01 and 02) and noted that while it correctly identified the need to schedule and conduct baseline structural inspections, it did not identify the need to establish criteria for reclassifying structures from category (a)(2) to (a)(1). The team noted that corrective actions for the findings were either in place or in progress.

c. Conclusions

The team concluded that the licensee's self-assessment activities were appropriately conducted and identified worthwhile issues. Use of independent personnel was considered a strength of the 1995 self-assessment. The team further concluded that Audit 96-MAINT-01 was also a worthwhile effort although it did not identify a significant deficiency in the structure monitoring program.

III. Engineering

E4 Engineering Staff Knowledge and Performance (62706)

E4.1 Engineer's Knowledge of the Maintenance Rule

a. Inspection Scope (62706)

The team interviewed system engineers and managers to assess their understanding of PRA, the MR, and associated responsibilities.

b. Observations and Findings

The team interviewed the system engineers assigned responsibility for selected SSCs, walked down systems with them, and determined that they were knowledgeable of their systems, the MR performance criteria for their systems, and where their systems stood with respect to the performance criteria. They had received training in the use of the PRA in risk assessment for their SSCs and appeared to be able to use applicable PRA data in assessing risks involving their systems. Each of the system engineers appeared to be knowledgeable concerning MR requirements for their respective systems. This was especially apparent in their understanding of unavailability, how to track it, and how to use it most effectively in monitoring system performance. System engineers also indicated that the MR was a useful tool in bringing poorly performing systems to the attention of station management.

c. Conclusions

The team noted that system engineers were generally experienced and knowledgeable, and their understanding of the MR and PRA was good. The team also noted that system engineers were actively involved in MR implementation and generally viewed the MR as a useful tool.

V. Management Meetings

X1 Exit Meeting Summary

The team discussed the progress of the inspection with licensee representatives on a daily basis and presented the inspection results to members of licensee management at the conclusion of the inspection on January 17, 1997. The licensee acknowledged the findings presented.

The team asked the licensee whether any materials examined during the inspection should be considered proprietary; none was identified.

PARTIAL LIST OF PERSONS CONTACTED

Licensee

J. Arora, Senior Engineer
D. Alley, Quality Assurance Supervisor
M. Beier, Manager - Quality Control
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R. Coad, Superintendent - Radiation Protection
L. Dohrmann, Manager - Quality Services
R. Donnellon, Director - Engineering and Services
D. Eschleman, Manager - Operations
J. Fawcett, Operations Coordinator
J. Freels, Manager - Regulatory Affairs
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L. Hughes, Manager - Davis-Besse Supply
C. Kraemer, Engineer - Licensing
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J. Lash, Plant Manager
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J. Michaelis, Manager - Maintenance
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LIST OF INSPECTION PROCEDURES USED

IP 62706:	Maintenance Rule
IP 40500:	Effectiveness of Licensee Controls in Identifying, Resolving, and Preventing Problems
IP 71707:	Plant Operations

LIST OF ITEMS OPENED

50-346/97002-01(DRS)	VIO	"Reliability Performance Criteria"
50-346/97002-02(DRS)	URI	"Structure Monitoring Criteria"

LIST OF ACRONYMS USED

AFW	Auxiliary Feedwater
CDF	Core Damage Frequency
CFR	Code of Federal Regulations
CREVS	Control Room Emergency Ventilation System
CCW	Component Cooling Water
DRS	Division of Reactor Safety
ECCS	Emergency Core Cooling Systems
EDG	Emergency Diesel Generators
EOP	Emergency Operating Procedure
EPRI	Electric Power Research Institute
FF	Functional Failure
IFI	Inspection Follow-up Item
INPO	Institute of Nuclear Plant Operations
IOE	Industry Operating Experience
IPE	Individual Plant Evaluation
IPEEE	Individual Plant Evaluation of External Events
MPFF	Maintenance Preventable Functional Failure
MR	Maintenance Rule
MRC	Maintenance Rule Coordinator
MRPM	Maintenance Rule Program Manual
NEI	Nuclear Energy Institute
NOV	Notice of Violation
NUMARC	Nuclear Management Resource Council
NRC	Nuclear Regulatory Commission
NRR	Nuclear Reactor Regulation
OE	Operating Experience
OER	Operating Experience Report
PDR	Public Document Room
PM	Preventive Maintenance
PRA	Probabilistic Risk Assessment
QA	Quality Assurance
RPS	Reactor Protection System
RSSM	Risk Significant System Matrix
SE	System Engineers
SER	Safety Evaluation Report
SFAS	Safety Features Actuation System

LIST OF ACRONYMS USED (cont'd)

SRO	Senior Reactor Operator
SSC	Structures, Systems or Components
URI	Unresolved Item

LIST OF DOCUMENTS REVIEWED

Maintenance Rule Program Manual, Rev. 02, December 15, 1996

Individual Plant Examination for the Davis-Besse Nuclear Power Station, February 1993

Individual Plant Examination of External Events for the Davis-Besse Nuclear Power Station, December 1996

Staff Evaluation Report Individual Plant Examination Davis-Besse Nuclear Power Station, Unit No. 1, Docket No 50-346, October 1996

Work Process Guideline, WPG-1, R04, June 28, 1996

Outage Nuclear Safety Control, NG-DB-00116, December 13, 1995

Equipment Out of Service Evaluation, NEN-95-10113, April 21, 1995

Risk Significant Structures, Systems, and Components (SSCs), NEN-95-10115, May 1, 1995

Reliability Performance Criteria, DBE-97-00011, January 9, 1997

Monitoring Reliability for the Maintenance Rule, EPRI Technical Bulletin 96-11-01, November 1996

Maintenance Unavailability Sensitivity Analysis (Performance Criteria), C-NSA-99.16-18, Rev. 1, January 8, 1997

Maintenance Unavailability Analysis (Measured Performance), C-NSA-99.16-19, October 15, 1996

DB-PF-00002, Preventive Maintenance Program

NG-QA-00702, Potential Condition Adverse to Quality

M/S DG-26, Design Guideline For Maintenance Rule Evaluation of Structures

Cycle 9, Periodic Maintenance Effectiveness Assessment Report

Cycle 10, Periodic Maintenance Effectiveness Assessment Report

Windows Report, Third Quarter 1996

LIST OF DOCUMENTS REVIEWED (cont'd)

System Engineering Handbook

C-NSA-99.16-19, Maintenance Unavailability Analysis (Measured Performance)